

Brain Injury Facts

Severe Brain Injury

Interview with Dr. Rolf B. Gainer, Ph.D.

Rolf B. Gainer, Ph.D. is the founder and Chief Executive Officer of the Neurologic Rehabilitation Institute at Brookhaven Hospital and the Neurologic Rehabilitation Institute of Ontario (Canada). Dr. Gainer is a psychologist who has been involved in the design and operation of community based rehabilitation programs for people with a brain injury since 1977. He has presented papers at many conferences in the United States and Canada in the area of post-acute brain injury rehabilitation. Dr. Gainer's professional interests include: the rehabilitation of individuals with complex care problems, neurobehavioural syndromes and dual diagnosis. He is active in outcome research and currently is involved in three outcome study projects.

What is a severe brain injury? A **severe brain injury** occurs when trauma to the brain produces a significant neurological injury, resulting in physiologic changes to a person's brain. Four types of injury may cause trauma to the brain:

- . Closed head injuries occur when the brain tissue is injured by hitting the inside of the skull. This can cause bleeding, bruising, tissue damage and increased intra-cranial pressure or fluid buildup
- . Penetrating injuries include open fractures of the skull, gunshot wounds, and the entry of any foreign object into the brain
- . Anoxic injuries occur when the lack or reduction of oxygen causes brain cells to die.
- . Toxic injuries are caused by exposure to certain toxic chemical agents, which can cross the blood brain barrier and damage or kill brain cells.

How is severity determined? Brain injury is commonly rated at three levels using the terms: mild, moderate and severe. The severity of an injury indicates the extent of damage to the brain and the effects of the neurological injury on other body systems. The **Glasgow Coma Scale** rates injury severity following an injury and determines how responsive the person is to behavioural measures. There is also a **Glasgow Outcome Scale**, which is used at various points following an injury to determine the prognosis or likelihood of the person regaining his or her independence. Other measures, like the **Rancho Los Amigos Scale**, are used to assess consciousness, responsiveness and receptive skills.

What are the clinical features of severe brain injury? Severe brain injury is characterized by a low Glasgow Coma Scale at the time of the initial medical intervention. Usually there is also a second assessment at twenty-four hours after the injury. The individual is often in a coma or a state of diminished consciousness, which lasts for hours, and may extend to days or weeks. Symptoms often include:

- . Reduced ability to respond to stimuli
- . Changes in muscle tone
- . Difficulties in respiration and other vital functions
- . Increased intra-cranial pressure or fluid buildup, requiring monitoring and, in some cases, neurosurgery.

We often see other severe physical injuries, such as fractures of the skull and internal injuries. Overall, the key medical goal is to maintain vital functions while assessments and interventions are carried out to address the multiple physical injuries and the effects of the brain injury.

What is the frequency of severe brain injury? In North America:

- . There are 200 brain injuries at all levels of severity in every 100,000 people
- . Severe brain injuries occur in approximately 15% of brain injuries
- . Mortality from brain injury occurs in approximately 11% of the injuries
- . There are over 1 million new cases of brain injury each year
- . Motor vehicle accidents account for 60% of the brain injuries
- . Work-related accidents account for 15%
- . Sport-related accidents account for 15%
- . Assault-related injuries, including gunshots, account for 10% While most injuries are in the mild category, brain injury at all levels can create affects which last a lifetime. Severe injuries have a greater likelihood of producing lifelong effects.

Do seat belts and airbags prevent brain injury? Yes. Seat belts and airbags save lives by reducing injury severity. All safety devices (i.e. helmets, seat belts, airbags, etc.) are critical to increasing safety and preventing injury in motor vehicle, bicycle and sporting accidents. Due to the use of safety devices, more people survive accidents which otherwise would be fatal. This increased survivorship has resulted in an increase of people with severe brain injuries. In addition to advanced safety systems,

the tremendous increase in technology available to emergency and neurosurgical medicine has also reduced the number of fatalities from brain injury. Med flight services extend lives by getting injured people to hospital care within minutes of the accident.

Increasing safety awareness and exercising good judgment are also important. Driving while under the influence of drugs or alcohol—or even some prescription medication—increases the likelihood of accidents. We must work to prevent brain injuries through safety-awareness programs.

How does a severe brain injury affect the individual? A severe brain injury produces physiologic, cognitive, emotional, psychological and behavioural changes. Some individuals develop medical problems related to specific deficits caused by the brain injury. The part of the brain that is injured determines the long-term effects. Often a severe brain injury involves multiple areas of the brain, resulting in multiple disabilities. Physical functions can be affected, such as standing, walking, and eye-hand coordination. Cognitive changes can include issues with memory and language. Personality traits can be affected. People may lose their natural inhibitions and behaviour control, leading to inappropriate behaviour. The effects of a brain injury can be extremely widespread, impacting all areas of a person's life and requiring extensive medical and rehabilitative treatment.

What is the course of recovery? Following the accident, a person with a severe brain injury requires **medical stabilization** to monitor and manage basic life systems such as respiration. Many individuals need **neurosurgery** to control bleeding inside the brain or between the brain and the skull, repair damaged tissue, or control fluid pressure within the brain. These procedures are invasive and generally require that a highly specialized medical team perform many delicate and involved processes. There may be a phase of **intense medical supervision** in an Intensive Care Unit (ICU) or in a Neurological Intensive Care Unit (NICU). As the person stabilizes and the life threatening aspects of the injury subside, he or she is considered for a hospital-based **medical rehabilitation program**. The medical rehabilitation program provides restorative therapies such as **physiotherapy, occupational therapy and speech therapy**, while continuing to provide medical and nursing supervision. Once hospital-based rehabilitation has been completed the person may require a community-based program or ongoing outpatient rehabilitation services. In cases where the injury has caused severe and persisting deficits and high care needs, the person may require ongoing rehabilitation in extended or long-term care environments. In these cases, transitional and supported living programs may be appropriate.

How much can a person expect to recover from a severe brain injury? This depends on the areas of the brain that were injured and the extent of the injury. There is a window of time after the injury that is called the **spontaneous recovery period**. This is when the brain attempts to recover and repair the bruised neurons. The process takes weeks and may extend for months beyond the date of the injury. Rehabilitation helps stimulate the brain to retrain other neurons to take the place of those that have died. Often a person must relearn physical skills as well as functional skills. Through rehabilitation, the person also learns to use adaptive strategies and apply skills to solve the problems they are experiencing in their recovery. Therapeutic intervention should begin as soon as the person is medically stable. The recovery process can only be measured individually due to the complexity of the brain and its ability to continue recovery over time. The return of functional skills continues for years following the injury.

How does rehabilitation influence recovery? In the early phases of rehabilitation, the focus is on maximizing the natural recovery process. Specific deficits or problem areas are identified, and treatment is directed at improving function within these areas. As the person progresses through rehabilitation, the focus shifts towards replacing skills and functions that have been lost. In the post acute phase of rehabilitation, the emphasis is on functional skills retraining. **Relearning and adaptation** are heavily emphasized in brain injury rehabilitation. We have learned that the human brain is capable of overcoming significant problems created by injury. Effective rehabilitation takes people from a medical environment into the community and even into their homes, schools or workplaces. With that approach, the rehabilitation professionals can develop strategies and interventions with the individuals, which are customized for their unique problems.

What are the phases or steps involved in rehabilitation? No two brain injuries are alike and the course of rehabilitation is different for each participant. Individuals progress through rehabilitation at their own pace and require unique rehabilitation programs. In the **acute or medical phase**, the emphasis is on enhancing natural recovery and establishing strategies that promote independence. In the post-acute phase, the emphasis is on teaching functional skills and bringing rehabilitation into the individual's home, work, community and school.

What happens after rehabilitation ends? For some people rehabilitation is a lifelong process. They may continue to benefit from various rehabilitation therapies to maintain skills and to learn new skills required by their increased independence and community mobility. Many individuals return to their pre-injury roles at home, at work and in the community. There are also people who require continued support and assistance in certain aspects of their lives. This support and assistance may come from family members, trained rehabilitation professionals and paraprofessionals. The goal of rehabilitation is to assist each

person in returning to a life of independence, self-worth and dignity. As people with brain injury go through the aging process, specialized support services are needed to assist them in maintaining their independence.

What happens to children with severe brain injuries? Children with severe brain injury have the advantage of age on their side. Young children can train their brains to replace lost functions more easily than adults can with similar injuries. Yet, brain injury for children can create many cognitive or learning problems. Additionally, psychological and behavioural problems may affect school re-entry and a return to family and peers. Many children require rehabilitation that extends into the school environment to achieve success.

Do some people remain in a coma forever? The term **coma** is generally used to describe a person whose ability to respond to stimuli is significantly reduced. However the term can be misleading. In some cases, the significant alterations of consciousness that we see in severe brain injury persist. The term **persistent vegetative state** is used to describe individuals who do not recover from coma following their injuries. Little is known about what people hear or see while in a coma. We believe that people in a state of coma are aware of their environments, of people and of events. This understanding has dramatically changed how individuals in comas are treated. A prolonged state of diminished consciousness is called a **minimally conscious state** and requires an effective program that:

- . Provides gentle, but consistent stimulation.
- . Involves all of a person's senses.
- . Enables an individual to interact with his or her environment.

What is a "locked-in" syndrome? For a long time we thought that individuals who were in a state of diminished consciousness were unable to respond. Through years of working with people with severe brain injuries and diminished responding capacities we have learned that the person may be receiving information but be unable to produce an effective response. Some people may communicate with an eye blink, a facial gesture or even by moving a toe. The term "locked in" syndrome has been used to describe the state in which the person has become unable to effectively respond to stimulation. Rehabilitation services for these individuals may focus on developing a communication system in addition to maintaining physical conditioning and health.

What are cognitive problems? Cognitive problems are specific skill deficits that may occur following a brain injury. Some of the most common cognitive problems are:

- . Arousal or over-stimulation
- . Attention and filtering
- . Information coding and retrieval (memory)
- . Learning, both using old information and acquiring new information
- . Problem Solving
- . Higher-level thinking skills known as **executive skills**. Some cognitive problems clear over time and through rehabilitation, while others may persist and require specific rehabilitation interventions. There is a relationship between cognitive problems and neurobehavioural problems.

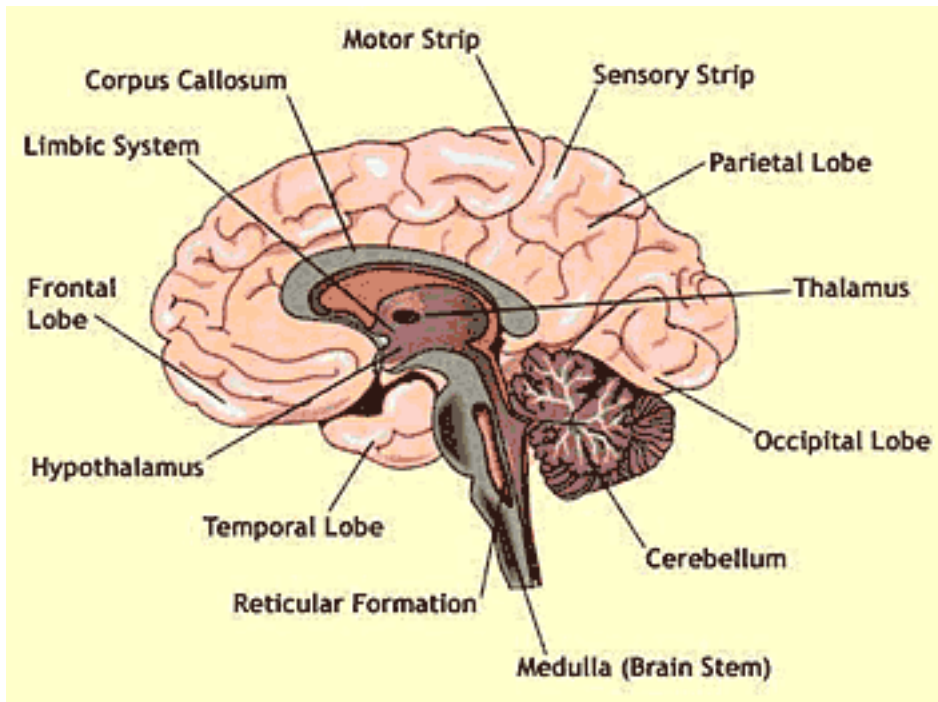
What are neurobehavioural problems? Neurobehavioural problems are behaviour problems that are attributed to specific aspects of a brain injury. Sometimes normal inhibitions and judgment are reduced due to the injury. Individuals may develop difficulty with self-regulation or self-control, impulse control, over arousal, frustration tolerance and problems in perception. They may overreact to situations, get angry without provocation, or behave in socially inappropriate ways. In some cases, medications are effective in assisting them with behaviour control. A neuropsychologist may help design an appropriate behaviour learning strategy.

What causes the inability to control anger and aggression after injury? There is a correlation between the location of the brain lesion and the appearance of anger and aggression. This trait is frequently present when the lesions affect the frontal lobe. Anger and aggression seem to be caused by a reduction of impulse control as the result of the brain lesions.

What causes difficulty controlling emotions and inappropriate sexual behaviour? This is similar to the question about anger and aggression. Following a brain injury, some people lose appropriate boundaries when they experience sadness, happiness, and sexual feelings. This loss of inhibition and impulse control can result from the location of their brain lesions, or the trauma of the brain injury. Often a psychiatrist or psychologist who specializes in neurological cases is needed to help the person deal with the injury in a healthy way.

What is a brain stem injury? The brain stem controls many physiologic systems. An injury to the brain stem is likely to create problems in mobility (gait), motor control and central functions. This could result in difficulty standing, walking, getting in and out of a bed or chair, lifting, throwing, catching, feeding oneself, writing, and performing other normal daily activities. People

with brain stem injuries tend to require a prolonged period of medical supervision and may have long-term physical deficits related to their brain stem injuries.



What is a frontal lobe injury?

The **frontal lobes** control many cognitive and behavioural functions through complex processes of integrating and mediating responses. Neuropsychologists relate **executive deficits** (problems in higher-level thinking) to frontal lobe injuries. Many aspects of frontal lobe function are important for the control of our thinking and behaviour. Frontal lobe injuries are common due to the structure of the brain and adjacent skull areas.

Most severe brain injuries involve the effects of one or both of the following:

- . Contra coup injuries in which the brain moves in a back and forth motion, striking the skull.
- . Rotational or shearing injuries, which are caused by the sideways movement or twisting of the brain inside the skull, stretching and tearing neurons that form essential connections.

Does the location of an injury effect severity? The location of the injury can affect the severity of the problems experienced by individuals throughout the course of their recovery, rehabilitation, and lifetime. The brain is a complex part of our neuroanatomy. Controls for physical, cognitive, emotional and behavioural functions are all brain-based. We see few simple injuries. Most are complex and affect more than one aspect of brain-based functions. Certainly specific or “focal” injuries produce specific deficits and problems. The circuitry of the brain is extremely complex.

What are neuromotor problems? Neuromotor problems are physical movement and body control difficulties resulting from injury to the motor control areas of the brain. People may experience difficulty:

- . Initiating or starting a movement
- . Maintaining muscle control
- . Sustaining a movement
- . Executing a complex movement such as walking Specific therapies can help a person regain motor control and maximize motor skills. Much of our ability to live with independence relates to our capacity to perform motor tasks.

In your opinion, what is the likelihood of a person returning to a life of independence after a brain injury? Although there are no guarantees, many people are able to make dramatic strides. We see continued improvement, sometimes years after the injury. In many cases people are able to return to lives filled with purpose and meaning with the people they love.